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Peer reviewed

## ARTICLE



# Current opinions on the management of prolonged ischemic priapism: does penoscrotal decompression outperform corporoglanular tunneling?

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Prolonged ischemic priapism presents a treatment challenge given the difficulty in achieving detumescence and effects on sexual function. To evaluate current practice patterns, an open, web-based multi-institutional survey querying surgeons' experience with and perceived efficacy of tunneling maneuvers (corporoglanular tunneling and penoscrotal decompression), as well as impressions of erectile recovery, was administered to members of societies specializing in male genital surgery. Following distribution, 141 responses were received. Tunneling procedures were the favored first-line surgical intervention in the prolonged setting (99/139, 71.2% tunneling vs. 14/139, 10.1% implant,  $p < .001$ ). Although respondents were more likely to have performed corporoglanular tunneling than penoscrotal decompression (124/138, 89.9% vs. 86/137, 62.8%,  $p < .001$ ), penoscrotal decompression was perceived as more effective among those who had performed both (47.3% Very or Extremely Effective for penoscrotal decompression vs. 18.7% for corporoglanular tunneling;  $p < .001$ ). Many respondents who had performed both tunneling procedures felt that most regained meaningful sexual function after either corporoglanular tunneling or penoscrotal decompression (33/75, 44.0% vs. 33/74, 44.6%,  $p = .942$ ). While further patient-centered investigation is warranted, this study suggests that penoscrotal decompression may outperform corporoglanular tunneling for prolonged priapism, and that recovery of sexual function may be higher than previously thought after tunneling procedures.

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## INTRODUCTION

Ischemic priapism is a true urologic emergency; if not addressed promptly, the inevitable result is tissue hypoxia, ischemia, and progression to corporal fibrosis [1, 2]. This ultimately leads to erectile dysfunction, with the likelihood of meaningful sexual function recovery declining rapidly with increased priapism duration [3–5]. Effective treatment requires timely decompression and re-establishment of corporal perfusion to relieve the compartment syndrome and avoid this fate [6, 7].

Restoration of perfusion has traditionally been obtained by creating distal or proximal shunts, although the latter are discouraged in the most recent American Urological Society/Sexual Medicine Society of North America guidelines due to poor efficacy [8]. Distal shunts theoretically function in two ways: first by surgical decompression and removal of the deoxygenated blood, and second by creation of a shunt between the glans and the underlying corpus cavernosum [9]. Distal shunts are less effective in cases of prolonged priapism, however [5], and thus various tunneling maneuvers have been introduced in an effort to improve outcomes. Both corporoglanular tunneling (CGT) and

penoscrotal decompression (PSD) function by mechanically disrupting the ischemic coagulum and have been shown to be effective in resolving priapism, even in the prolonged setting (Fig. 1) [10, 11].

To our knowledge, analysis of contemporary practice patterns regarding the management specifically of prolonged ischemic priapism has not been performed. We sought to query a broad range of thought leaders worldwide specializing in male genital surgery. To this end, we developed a multi-institutional survey assessing current practice patterns for the management of prolonged ischemic priapism as well as surgeon impressions regarding the efficacy of and sexual recovery following surgical intervention.

## MATERIALS & METHODS

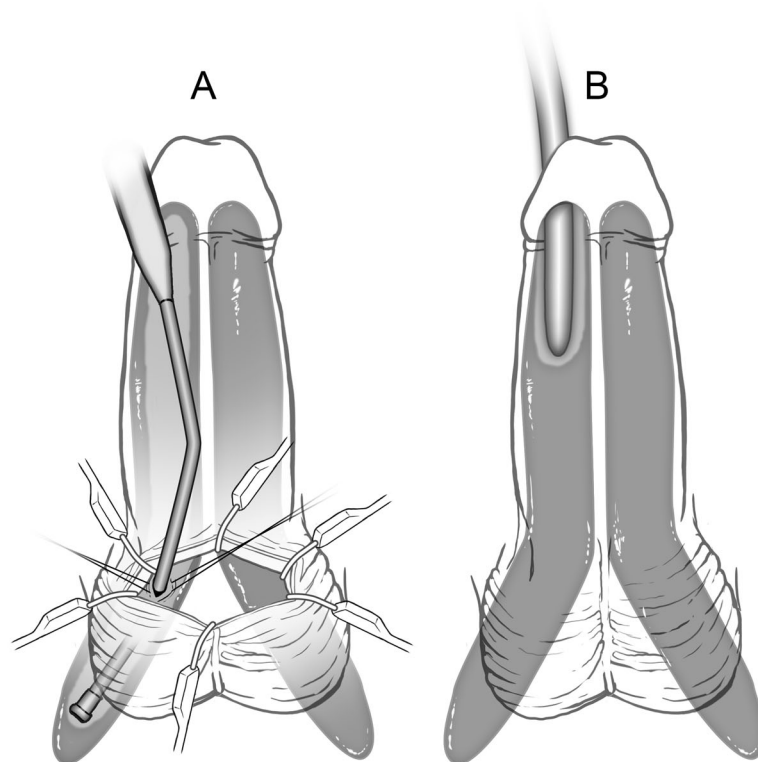
### Survey design and distribution

A 38-question, web-based open survey was designed through the collaboration of the authors and distributed to subspecialty surgeons including members of the Society of Genitourinary Reconstructive Surgeons, the Sexual Medicine Society of North

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**Fig. 1** Tunneling operations for priapism. **A** shows penoscrotal decompression, **B** shows corporoglanular tunneling.

America, and the European Society for Sexual Medicine. A link to the survey was promoted on the individual society websites and via emails sent to the society distribution lists. Participation in the survey was voluntary; no incentives were offered for completion. Incomplete questionnaires were included in the analysis. The full survey is available for review (Supplemental Fig. 1).

Surgeons were queried regarding preferred first-line interventions for both acute ischemic priapism (duration <24 h) and prolonged ischemic priapism (duration  $\geq$ 24 h at presentation). Questions highlighted experience with – and perceived efficacy of – advanced maneuvers including CGT and PSD. Also queried were surgeons' impressions of the prevalence of erectile dysfunction after priapism intervention. As this study collected no personal patient information and instead comprised an anonymous survey of surgeon opinion, it was determined to be exempt from requiring IRB review.

### Statistical analysis

Statistical analysis was performed in Microsoft Excel 2016 and the R language and environment for statistical computing (R Foundation for Statistical Computing, Vienna, Austria). Categorical variables were assessed with Fisher Exact or Chi-square analysis as appropriate.

## RESULTS

### Respondent characteristics

Over a 2-month distribution period from September to November 2022, 141 survey responses were received; background characteristics of respondents are reflected in Table 1. Most respondents (103/141, 73%) had completed a fellowship, most commonly through the Society of Genitourinary Reconstructive Surgeons (44/103, 42.7%) or the Sexual Medicine Society of North America (26/103, 25.2%). The majority practiced in an academic setting (94/141, 66.7%) while 27.0% (38/141) reported working in a private practice setting. Approximately two-thirds reported being in practice for  $\leq$ 10 years, with the remaining third being in practice

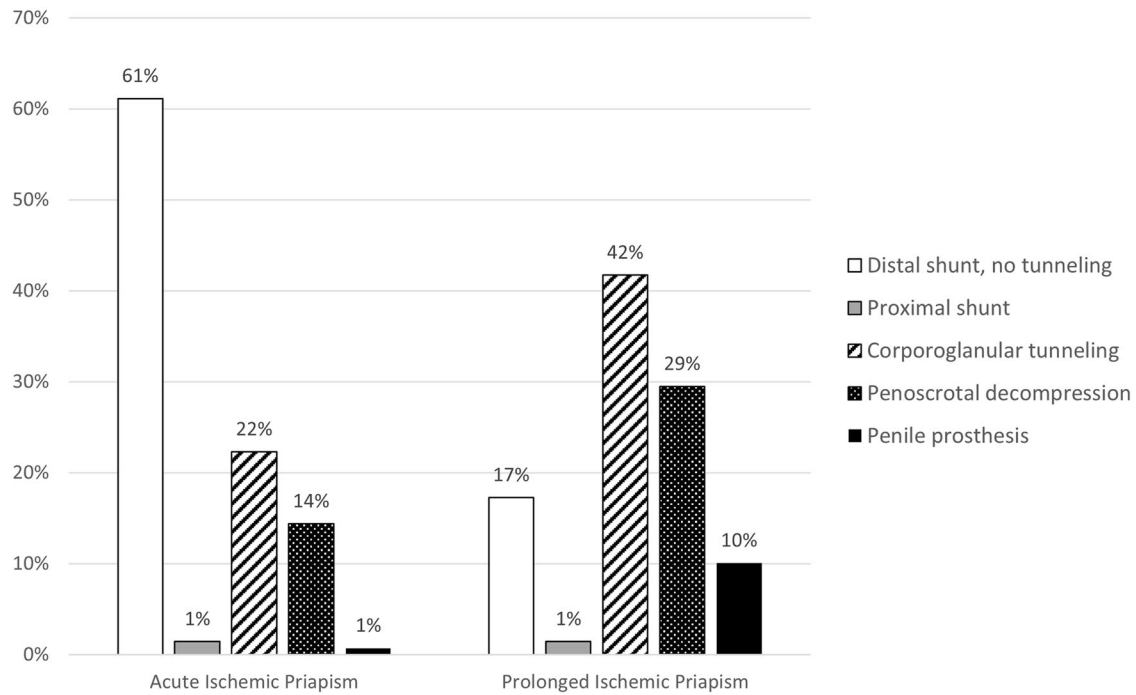
**Table 1.** Respondent Background Characteristics.

	No. Responses (%)
Did you complete a fellowship (yes)?	103/141 (73)
Fellowship completed:	
Society of Genitourinary Reconstructive Surgeons	44/103 (43)
Sexual Medicine Society of North America	26/103 (25)
European Society for Sexual Medicine	6/103 (6)
Other	28/103 (27)
Number of years in practice	
<5	57/141 (40)
5-10	42/141 (30)
11-20	18/141 (13)
>20	24/141 (17)
Practice setting	
Academic	94/141 (67)
Private	38/141 (27)
Other	9/141 (6)
Number of priapism episodes per year	
<5	53/140 (38)
6-10	65/140 (46)
>10	22/140 (16)

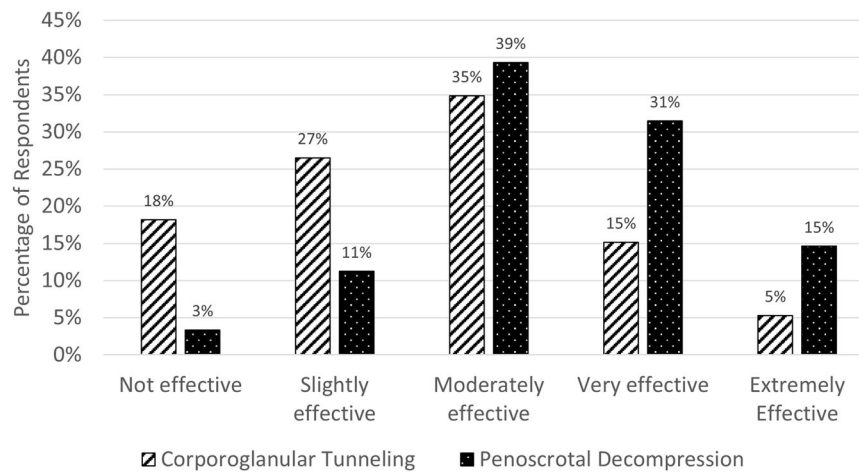
>10 years. The most common number of priapism episodes treated annually was 6-10 (46.4% of respondents).

### Choice of surgical intervention for priapism

Simple distal shunts were the preferred first-line surgical intervention for acute ischemic priapism (<24 h duration) after



**Fig. 2** Surgeon-preferred First Line Surgical Interventions for Acute and Prolonged Ischemic Priapism.



**Fig. 3** Perceived efficacy of tunneling procedures for prolonged ischemic priapism.

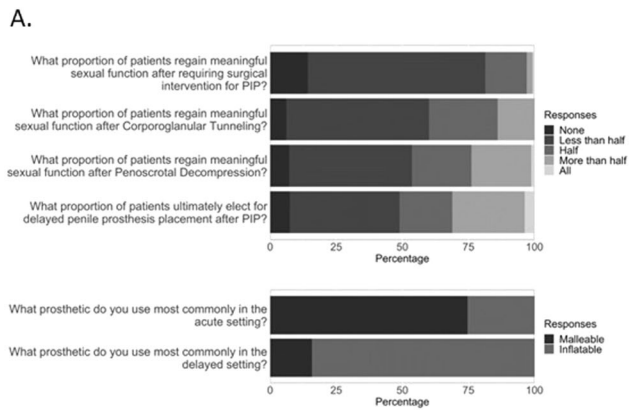
failed irrigation/aspiration (85/139, 61.2% distal shunt vs. 51/139, 36.7% tunneling,  $p < .001$ , Fig. 2). In the prolonged setting, by contrast, tunneling procedures were the most commonly chosen first-line surgical intervention (99/139, 71.2% tunneling vs. 14/139, 10.1% implant,  $p < .001$ ). Respondents were more likely to have performed CGT (124/138, 89.9%) than PSD (86/137, 62.7%),  $p < .001$ .

Among respondents who had performed both techniques, PSD was felt to be more than twice as effective at resolving prolonged ischemic priapism (Fig. 3), with PSD reported as “Very or Extremely Effective” by 47.2% (35/74) versus only 18.7% (14/75) for CGT,  $p < .001$ . Among those with recurrent priapism after CGT, PSD was the preferred salvage procedure for 49/121 (40.5%), while immediate implant was favored by 54/121 (44.6%); this difference was not significant ( $p = .516$ ). By contrast, penile prosthesis was the preferred salvage procedure for recurrent priapism after PSD for 83.1% (74/89); only 2.2% (2/89) reported they would perform CGT in this setting ( $p < .001$ ).

### Impressions of sexual function recovery

With regards to sexual function, respondents overwhelmingly felt that most patients have significant erectile dysfunction after prolonged ischemic priapism; 81.3% (109/134) responded that they perceived less than half of patients as having meaningful erectile function after operative management (Fig. 4A). Patients were felt to have higher likelihood of sexual recovery after tunneling procedures, where 42.7% (85/199) felt that at least half of patients regained sexual function compared to only 18.7% (25/134) after intervention in general ( $p < .001$ , Fig. 4B). PSD and CGT were seen as having equivalent sexual outcomes; a similar number of respondents who had performed both procedures felt that at least half of patients regained meaningful sexual function after tunneling (33/74, 44.6% PSD vs. 33/75, 44.0% CGT,  $p = .942$ ).

Surveyed urologists were split on what proportion of patients ultimately pursued penile prosthesis surgery after an episode of prolonged ischemic priapism; 49.6% (65/131) responded that less than half of their patients elected for prosthesis and 50.4%



**Fig. 4 Impressions Regarding Recovery of Sexual Function. A** Survey responses regarding recovery of sexual function and penile implant trends after prolonged ischemic priapism. **B** Perceived rates of sexual function recovery after tunneling procedures versus surgery in general for prolonged ischemic priapism.

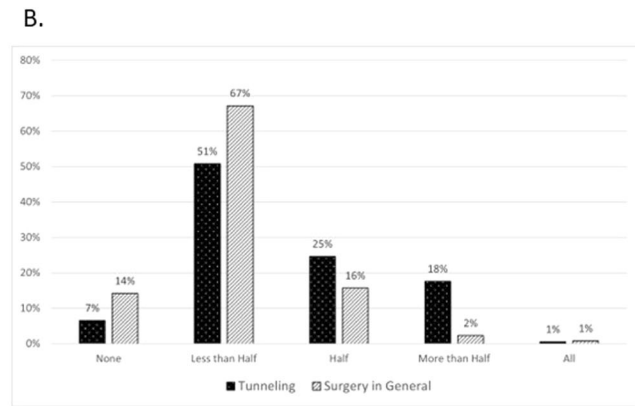
(66/131) responded that at least half desired prosthesis placement (Fig. 4A). The vast majority (88.7%, 110/124) felt that prosthesis placement is more difficult after priapism, especially if performed in the delayed setting. With regards to device chosen, 75.2% (94/125) of urologists preferred malleable penile prostheses in the acute implant setting (i.e. at the time of priapism event), while in the delayed setting inflatable models were preferred by 84.1% (111/132).

## DISCUSSION

Prolonged ischemic priapism is a challenging entity; after 24 h, the likelihood of achieving detumescence with interventions such as aspiration/irrigation and injection of sympathomimetic agents is vanishingly small [5]. After this point, surgical intervention is nearly always mandatory to evacuate the ischemic coagulum and restore blood flow [12]. Compared to distal shunts alone, tunneling procedures allow more extensive disruption of this coagulum, and their increasing role is reflected in their inclusion in the 2021 American Urological Association/Sexual Medicine Society of North America acute ischemic priapism guideline [8]. Our international survey confirms that tunneling procedures are now viewed as the procedure of choice in this challenging setting. Moreover, among those who had performed both procedures, PSD was identified as being more effective than CGT at resolving ischemic priapism in the prolonged setting.

### A paradigm shift in the management of prolonged ischemic priapism

Nearly three-quarters of respondents reported that tunneling procedures were their intervention of choice for prolonged ischemic priapism, reflecting a paradigm shift away from early penile prosthesis placement. Respondents in our survey were more likely to have tried CGT than PSD, which may reflect the fact that the former was described nearly a decade earlier. Corporoglanular tunneling was first described in 2009 as a modification of the Al-Ghorab distal shunt; at 6-month follow-up, 8 of 10 patients had no recurrence of priapism, while 2 required IPP [13]. Penoscrotal decompression, which was first introduced in 2018, functions in a similar manner by disrupting the ischemic coagulum; initial studies reported a 93% success rate [14]. Compared to CGT, the penoscrotal approach allows easier access to the proximal corporal bodies while avoiding violation of the distal corpora. This has potential benefits in minimizing the likelihood of distal extrusion if a penile prosthesis is ultimately placed [15]. To date, no head-to-head comparison has been performed to compare the efficacy of these two tunneling approaches. Subjectively, our study showed that among surgeons



who had performed both procedures, PSD was perceived to significantly outperform CGT in the setting of prolonged ischemic priapism.

### Penoscrotal decompression in practice

The majority of respondents in this study were fellowship-trained and worked in an academic setting. On sub-group analysis, fellowship-trained urologists as a whole were no more likely to choose a tunneling procedure as first-line intervention for prolonged ischemic priapism (versus traditional shunts or immediate penile prosthesis) than non-fellowship trained urologists. However, US fellowship-trained urologists were more than twice as likely to choose PSD as their first line intervention versus their non-US fellowship-trained colleagues. Academic urologists were slightly more likely to pursue tunneling procedures as first-line surgery for prolonged ischemic priapism than their private practice counterparts, but this did not reach significance ( $p = .160$ ). When looking specifically at PSD, though, academic urologists were significantly more likely to choose PSD as first-line intervention for prolonged ischemic priapism when compared to their private practice counterparts. Career duration was not found to affect choice of first line intervention; those who had been in practice for >10 years were just as likely to elect up-front tunneling procedures as those in practice  $\leq 10$  years.

### Does tunneling facilitate recovery of sexual function?

While in general the likelihood of recovering meaningful sexual function after a priapism episode lasting greater than 24 h is low [4, 5], some studies have suggested that tunneling procedures may improve this outcome. One study showed that 14.6% of men retained intact erectile function after CGT, and 52.6% were able to achieve penetration with the aid of phosphodiesterase-5 inhibitors or vacuum devices despite a median priapism duration of 58 h [16]. Early results of PSD are also promising, with 9 of 15 patients (60.0%) reporting erections firm enough for penetration with the aid of phosphodiesterase-5 inhibitors despite a mean priapism duration of 58.7 h [11].

Most survey respondents felt that sexual dysfunction was the norm after surgical intervention of any kind for prolonged ischemic priapism, with 81% stating that they perceived less than half of patients as regaining meaningful sexual function post-operatively. Tunneling procedures, however, were felt to be associated with significantly greater likelihood of sexual recovery, with PSD and CGT felt to have equivalent sexual function outcomes. Although these perceptions will need to be borne out in multi-institutional patient studies, it is promising that tunneling procedures are increasingly perceived as beneficial with regard to erectile recovery. This may result in fewer patients



ultimately requiring penile prosthesis placement acutely or remotely, potentially avoiding the cost and morbidity of additional surgery.

### The evolving role of the penile prosthesis for priapism

Early penile prosthesis insertion has traditionally been the procedure-of-choice in cases of prolonged or refractory priapism as is reflected in both the American Urological Association and European Association of Urology guidelines [7, 8]. Benefits of prosthesis placement during the acute episode include resolution of the corporal compartment syndrome, early recovery of sexual function, and potential avoidance of penile shortening from subsequent fibrosis [17]. Moreover, penile prosthesis placement is seen to be significantly easier in the acute setting before corporal fibrosis has developed; delayed prosthesis placement has been associated with higher risk of cross-over events, urethral injury, and infection [18–20]. Our survey results confirmed these perceptions, with the vast majority of respondents viewing prosthesis placement as more challenging in the delayed setting, especially if there is a significant delay between the acute episode and subsequent prosthesis surgery.

Even so, our survey suggests that subspecialty surgeons now prefer to attempt a tunneling procedure prior to placing a penile prosthesis, reflecting a distinct shift in the management of prolonged ischemic priapism. In fact, immediate penile prosthesis was only selected as the preferred first-line intervention by 10% of respondents in our survey. Interestingly, for patients with recurrent priapism despite CGT, respondents were evenly split between choosing PSD and immediate penile prosthesis. By contrast, prosthesis placement was by far the most common salvage intervention selected after priapism recurrence after PSD. Thus, it appears that for many urologists PSD is seen as a viable method to further avoid prosthesis placement in the acute setting.

MRI may be useful in this context, as recommended in the European Association of Urology guidelines [7]. The presence of smooth muscle necrosis on MRI has been shown to correlate with development of erectile dysfunction and may be useful in predicting which patients are more likely to require IPP [21]. Theoretically, this could be used to stratify patients to receive either a tunneling procedure or an up-front penile prosthesis. However, MRI has not yet been studied specifically in the context of tunneling procedures, and obtaining an MRI in the emergency room setting remains prohibitive at many centers.

Our survey raises the question of whether penile prosthesis may be avoidable altogether in some patients with prolonged ischemic priapism. Responses suggest that many patients are perceived as regaining sexual function after tunneling procedures – patients in whom immediate prosthesis placement would represent over-treatment. Multiple respondents also wrote in comments regarding the prohibitive cost and availability of prosthetics in the acute setting; certainly, in this aspect tunneling procedures may provide an advantage [22]. In this manner, prostheses might be reserved for those who truly require (and desire) them and avoids the necessity of the patient making such a significant decision in an emergency setting. The role of MRI specifically with regards to outcomes after tunneling remains to be studied.

In those patients who do ultimately require a penile prosthesis to regain erectile function, placement is more challenging given the development of corporal fibrosis, as noted by the overwhelming majority of survey respondents. However, multiple techniques have mitigated this challenge in recent years; vacuum devices increase corporal blood flow and suppress pro-fibrotic factors [23], and multiple advanced surgical maneuvers – such as use of extended corporotomies, counter-incisions, and cavernotomies – facilitate intra-operative dilation [24]. Lastly, the advent of small-diameter cylinders such as the AMS™ 700 Controlled Expansion Restricted (Boston Scientific, Marlborough, MA) and the Coloplast Titan® Narrow-Body (Coloplast Corp., Minneapolis,

MN) have further enabled the successful placement of IPP cylinders in these difficult cases.

### Limitations

Our study has inherent limitations; firstly, there is no specialty-wide agreement on the definition of “prolonged” ischemic priapism. We chose a time point of 24 h as a cut-off between acute and prolonged ischemic priapism for this study but recognize that a consensus view does not yet exist. The management of prolonged ischemic priapism is a nuanced one, depending on priapism etiology, prior history of priapism episodes, duration prior to presentation, and surgeon comfort with various maneuvers to achieve detumescence. Certainly, there is no “one size fits all” approach and we are not proposing that tunneling maneuvers in general or penoscrotal decompression specifically should be used as a first-line surgical management in every case. However, in the challenging setting of prolonged priapism at the time of presentation, tunneling procedures are increasingly seen as having an early role.

By its very nature this survey queried surgeon *perceptions* regarding practice patterns and the efficacy of tunneling maneuvers. These results are thus not necessarily reflective of true values and should not be taken as such. Similarly, surgeon perception of sexual function recovery is not necessarily reflective of true rates of recovery. Various adjuncts including vacuum erection devices and phosphodiesterase-5 inhibitors have also been proposed in the post-priapism setting to enhance sexual recovery, and these were not queried in this study. Given its rarity, ischemic priapism – and especially ischemic priapism of prolonged duration – is a difficult entity to study, even in a multi-institutional fashion. Certainly a multi-institutional, head-to-head trial of CGT versus PSD would be ideal to compare these modalities; however, this is unlikely to be clinically feasible given the rarity of this condition. In the absence of such a study, we feel that this survey provides valuable insight from subspecialty urologists around the world regarding their own experiences, albeit in a less objective manner.

Multiple methodological limitations exist. For multiple reasons, we are unable to report a true survey response rate, which limits the generalizability of this survey. Firstly, there is overlap between members of the groups surveyed, and thus some surgeons received the survey link more than once. Moreover, the survey was promoted through various means – on society websites and via email distribution. As view rates and individual IP addresses were not tracked, determination of a true survey response rate impossible. Given the anonymity of the survey and lack of IP address tracking, there was nothing to prevent a urologist from responding more than once and biasing the data. However, we find it unlikely that this would have happened given that the 38-question survey took more than 5 min to fill out. There was also no mechanism in place on the survey to determine which link respondents had clicked on; therefore, we cannot tell with certainty how many responses were received from each group.

Finally, this survey was sent to urologic subspecialty groups and not to general urologists; thus, the practice patterns of the general urologist may be somewhat different. Even so, these sexual medicine and reconstructive subspecialists are arguably the most informed regarding contemporary data. As such, perhaps their practice patterns should serve as a template for the general urologist who is less familiar with the relevant literature.

### CONCLUSIONS

Tunneling procedures are viewed as the procedure of choice for most subspecialty urologists in the management of prolonged ischemic priapism. Penoscrotal decompression is perceived to be more effective than corporoglanular tunneling in this setting and is commonly chosen as a salvage procedure when corporoglanular tunneling fails. Many surgeons feel that patients may regain

erectile function after tunneling procedures, potentially avoiding the need for expensive prosthetics.

## DATA AVAILABILITY

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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## AUTHOR CONTRIBUTIONS

MEV: survey design, survey implementation, data review, statistical analysis, manuscript preparation. WJS, LCH, BTL, BPF: survey design, survey implementation, data review. EGJ: data review, statistical analysis, manuscript preparation. BMD, BNB, NVJ, DWB, GAJ: survey design, manuscript review and preparation. FAY, MF, SJH, AFM: survey design, survey implementation, manuscript review and preparation.

## ETHICS APPROVAL

As this study collected no personal patient information and instead consisted of a survey of surgeon opinion, it was determined that ethics approval was not required.

## COMPETING INTERESTS

Mikkel Fode: Boston Scientific (speaker). Steven Hudak: Boston Scientific (consultant). Allen Morey: Boston Scientific (consultant, speaker), Coloplast (consultant, speaker). Faysal Yafi: Coloplast (advisory board, speaker), Cynosure (consultant), Halozyme (advisory board, speaker), Masimo (intellectual property), Promescent (advisory board), sprout (consultant), Xialla (advisory board). *The remaining authors have nothing to disclose.*

## ADDITIONAL INFORMATION

**Supplementary information** The online version contains supplementary material available at <https://doi.org/10.1038/s41443-023-00808-z>.

**Correspondence** and requests for materials should be addressed to Maia E. VanDyke.

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